

FINAL REPORT

ONR GRANT #: 14-88-J-1170

PROJECT TITLE: Polymer Research Initiation For Faculty From HBCUs

PRINCIPAL INVESTIGATOR: Dr. Kofi B. Bota

The purpose of the project was to introduce Dr. Fred I. Okoh and Dr. Leroy Frazier, both associate professors in the department of chemistry at Morris Brown College, Atlanta, GA to high performance polymer synthesis and characterization. The synthesis of the polymers involved polycondensation of comonomers. The faculty were also introduced to polymer characterization techniques, such as, optical polarizing microscopy, thermal analysis (differential scanning calorimetry and thermogravimetric analysis), Fourier transform nuclear magnetic resonance and infrared spectroscopy, and X-ray diffraction.

The first part of the research involved the synthesis and characterization of bicyclooctylene analogs of aramids (Kevlar® and Nomex®) as means of improving their processability. It was found that the Kevlar® analog polyamide was partially soluble in dimethylacetamide (DMAc) and N-methylpyrrolidone (NMP). The polymer formed lyotropic solutions in sulfuric acid and methane sulfonic acid. The Nomex® analog was soluble and formed lyotropic solutions in DMAc, NMP, sulfuric acid and methane sulfonic acid. Onset of decomposition was at 300 and 250 °C for the Kevlar® and Nomex® analogs, respectively. X-ray diffraction showed that the polymers were semi-crystalline.

The second part of the project involved the synthesis and characterization of processable polymeric precursors to aramids. Despite the highly desirable properties (high mechanical strength, high solvent resistance and high thermal stability, etc.) of aramids, their applications are limited due to the difficulty involved in processing. Most of the approaches involved in overcoming the processability problem are self-defeating, in that they compromise on the desirable properties of aramids. Our approach involved the synthesis of processable polymeric precursors to aramids, their fabrication into films and fibers followed by the subsequent conversion via thermal and chemical transformation to the more thermally stable aramid. This approach is outlined below.

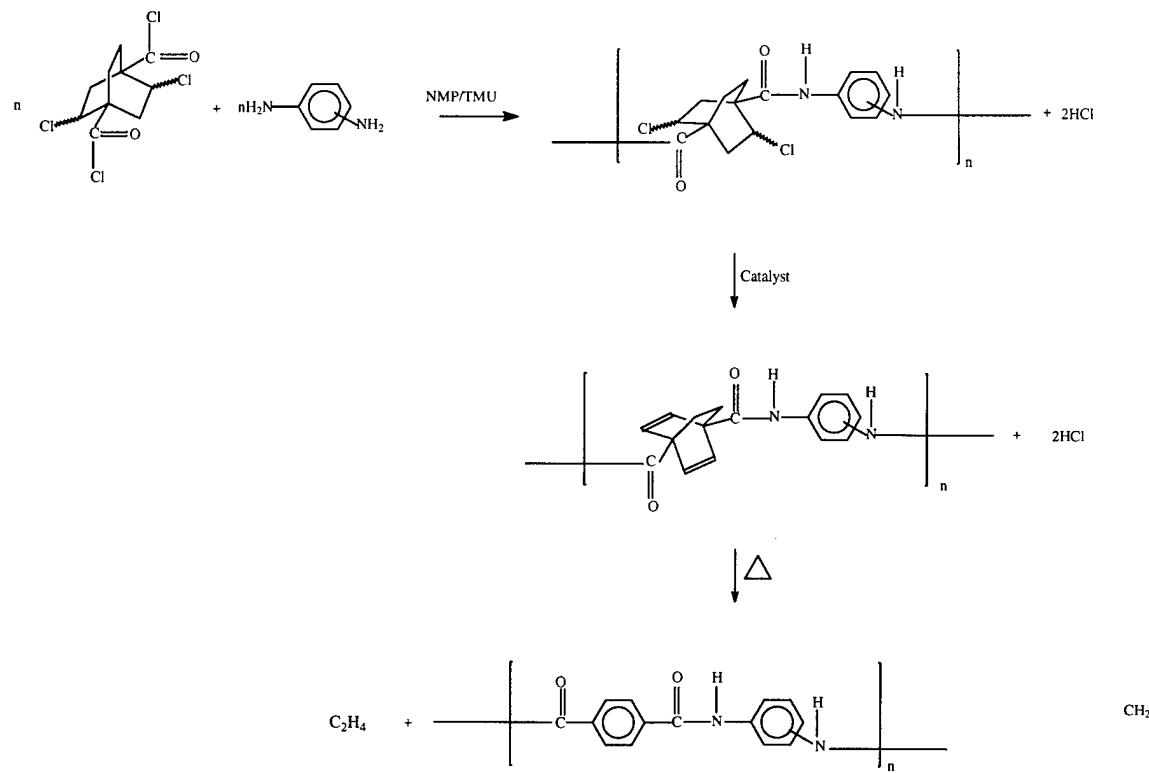
Processable aramid films and fibers were fabricated by making prearamid polymers containing the bicyclo[2.2.2]octane moiety substituted at the 2,5-position with chloro or acetoxy groups. The subsequent conversion to the desired aramid was performed by bulk pyrolysis with aromatization catalysts, such as, ZnCl₂ and 3,4-dichlorobenzene sulfonic acid. The prearamid polymers exhibited liquid crystalline behavior.

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PUBLICATIONS

Harruna, I. I.; Bota, K. B.; and MacLemore, S. D.,* "Precursor Polymers. 1. Synthesis and Characterization of Precursor Polymers to Aramids," *Polymer*, 34, 3328, (1993).

Harruna, I. I.; Bota, K. B.; Akinseye, T.;* Okoh, F. I.; "Precursor Polymers. 2. Synthesis and Characterization of Precursor Polymers to Aramids," *Polymer Prepr.*, 34, 453, (1993).

Bota, K. B.; Lu, Z.;* Harruna, I. I.; Okoh, F. I., "The Synthesis and Characterization of Copolyamides Containing the Bicyclo[2.2.2]octane Ring System," *Polymer Prepr.*, 31,1, 607, (1990).

PRESENTATIONS

"The Synthesis and Characterization of Copolyamides Containing the Bicyclo[2.2.2]octane Ring System," presented at the 202nd National Meeting of the American Chemical Society, Boston, MA, April 22 - 27 April 1990.

Precursor Polymers. 2. Synthesis and Characterization of Processable Precursors to Aramids," presented at the 205th American Chemical Society National Meeting, Denver, CO, April 1993.

**Student participants*

Miss Maclemore graduated with a M.S. degree in polymer chemistry in 1995 from Virginia Polytechnic Institute and State University, and will graduate from the University of Florida this summer (1997) with a Ph.D. degree in organic chemistry.

Mr. Akinseye graduated with a M.S. degree in chemistry with research in polymer chemistry from Clark Atlanta University in the summer of 1995.

Dr. Lu graduated in 1995 from the University of Arizona with a Ph.D. in polymer chemistry.